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Risk Factors for Diabetic Foot Ulceration Among Patients: A Cross-Sectional Study in Kirkuk City, Iraq

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Abstract **Background:** Diabetes Mellitus (DM) affects all body parts and is the 2nd foremost reason for blindness and foot ulcers globally. It can cause severe short/long-term complications extending from brain impairment to amputations and heart ailments. **Objectives**: To assess risk factors of Diabetic Foot Ulceration (DFU) among patients. **Methods:** A cross-sectional study was done at two Kirkuk Hospitals in Kirkuk City, Iraq, on 100 patients diagnosed with DFU from 1st November 2021 to 5th June 2022. A developed questionnaire comprised patients' sociodemographic data, medical data and assessment of risk factors causing DFU. **Results:** Most patients were males (54%), aged 60-69 years (40%), lived in an urban area (74%), married (78%), had a disease complaint of >9 years (66%), had hypertension (24%) and had a family history of DM (78%). Diseases in the peripheral nerves, smoking, foot injury, carelessness of the foot and not taking medications regularly were significantly associated with the chances of DFU. A significant difference between the risk factors of diabetic foot and each patient's age and education status ($p \leq 0.05$) was observed. **Conclusions:** The most profound risk factors were having diseases in the peripheral nerves, smoking, having injury in the foot, neglecting the foot and not taking medications regularly. Age, gender and education level directly correlated with the risk factors.

Key Words Diabetes Mellitus, Foot Ulceration, Non-Probability Sampling, Risk Factors

INTRODUCTION

Diabetes Mellitus (DM) is a debilitated chronic metabolic disease characterized by hyperglycemia resulting from defects in either insulin secretion, insulin action, or both. Several pathogenic processes are involved in the development of DM, including autoimmune destruction of the β-cells of the pancreas with consequent insulin deficiency and resistance to insulin action [1]. Diabetes affects carbohydrate, protein and fat metabolism, mainly caused by a deficient action of insulin on target tissues [2].

Recently, a gradual increase in the prevalence and incidence of diabetes has been observed; thus, early diagnosis of the disease is essential to avoid metabolic and cardiovascular complications in the short and long term. The common symptoms of DM that are caused by the development of hyperglycemia are polyuria, polydipsia, polyphagia, asthenia and weight loss. Early intervention with dietary, physiological activity and pharmacological measures in patients with prediabetes decreases the incidence of DM and cardiovascular complications [3].

Untreated DM can cause many complications, including acute and chronic abnormalities. Most of the organs, tissues and systems are affected due to long-standing DM, especially in adults and the elderly who often present to the clinics with multiple complications, such as foot ulceration, which is most common and affects 15% of patients during their disease lifetime [4]. Diabetic Foot Ulceration (DFU) is one of the significant health problems that can impair the quality of life, requiring prolonged hospitalization and entails high costs to the patient. Diabetic foot disease is 15 times more likely to undergo lower extremity amputation than their non-diabetic counterpart [5].

A great deal of emphasis, clinical and financial, is positioned on limb rescue efforts in diabetic patients with lower extremity ulceration, including proper oral medication, administration of intravenous antibiotics,

changing wound dressing, application of topical ointments and cleaning/elevation of the wound. All these efforts are done as amputations place a heavy burden on diabetic patients and their families. This is because of the impression that amputation in such patients may be a proximal cause of death. While amputation is undoubtedly an adverse clinical outcome, it is not entirely clear that it causes a dramatic death [6]. Accordingly, this study aimed to find the risk factors for DFU among patients of Kirkuk City, Iraq.

METHODS

Study Design and Setting

A quantitative, descriptive, cross-sectional study was conducted from 1st November 2021 to 5th June 2022. A non-probability (purposive) method was used to select the study sample of 100 patients who attended the Internal Medicine Clinic and Diabetic Clinic at Azadi Teaching Hospital and Kirkuk General Hospital in Kirkuk City, Iraq.

Inclusion Criteria

Patients with type 2 diabetes mellitus (T2DM) with foot ulceration.

Exclusion Criteria

Pregnant and lactating patients and those with T1DM, receiving chemotherapy or had mental problem.

Questionnaire

A validated questionnaire (by 10 experts in different specialties) was used to assess the risk factors of patients with DFU. The researchers constructed it and consisted of 3 parts. Part I covers sociodemographic data of patients, such as age, gender, residency, marital status and educational level. In contrast, Part II represents patients' medical data, such as the disease's duration, chronic diseases and family history of the disease. Part III is composed of risk factors for DFU and composed of 16 questions. The patients were given the questionnaire, which took them approximately 15-20 minutes to complete. Finally, a 2-likert rating scale was utilized (2 for Yes and 1 for No).

Statistical Exploration

Statistical Package for the Social Sciences (SPSS, version 26, Chicago, USA) was used for data calculation. The results were presented using appropriate descriptive and inferential methods. Differences set as significant at $p \leq 0.05$ and highly significant at $p \leq 0.001$.

RESULTS

Table 1 demonstrates that most patients were males (54%), aged 60-69 years (40%), illiterate (24%), from urban areas (74%) and married (78%). Figure 1 shows the duration of disease complaints that were ≥9 years in most patients (66%) and were <one year in least patients (2.0%). Figure 2 demonstrates the medical data of the patients, in which the common concomitant diseases were hypertension (24%), followed by heart/joint diseases (16%) and poly nephritis/kidney diseases (12%). Figure 3 demonstrates that 78% of the patients had a family history of DM. Table 2 shows that the most significant risk factors of patients with DFU were items number 2 (diseases in the peripheral nerves), 4 (smoking), 7 (foot injury), 9 (not taking care of the foot) and 10 (not taking the medications regularly), while less probability effect at other items.

Table 3, 4 and 5 show significant differences between risk factors of diabetic foot and patients' age, gender and education level ($p \leq 0.05$).

Table 1: Sociodemographic characteristics of the study samples

Variable	Frequency	Percentage
Gender		
Male	54	54
Female	46	46
Age (Years)		
30-39	2.0	2.0
40-49	6.0	6.0
50-59	18	18
60-69	40	40
≥70	34	34
Educational level		
Illiterate	24	24
Read and write	20	20
Primary school	16	16
Secondary school	10	10
High school	12	12
Institute	14	14
Collage and above	4.0	4.0
Marital status		
Married	78	78
Unmarried	22	22
Residency		
Rural	26	26
Urban	74	74
Total	100	100

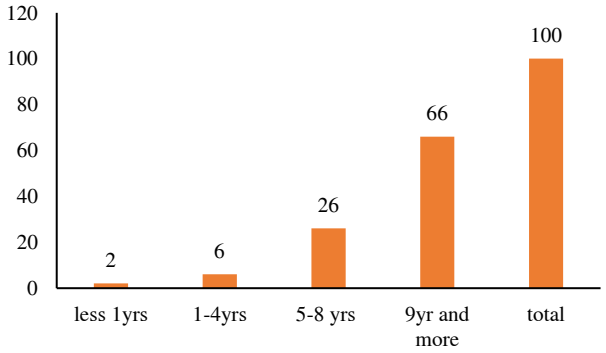

Figure 1: Duration of disease complaint among patients

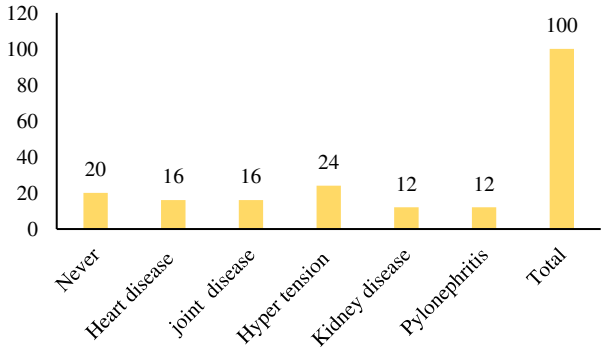

Figure 2: Concomitant chronic diseases among patients

Table 2: Risk factors among diabetic patients with foot ulceration

No.	Item	Yes		No		MOS	Significance
		No.	%	No.	%		
1	Do you have diseases of the vascular vessels?	46	46	54	54	1.46	NS
2	Do you have diseases in the peripheral nerves?	72	72	28	28	1.72	S*
3	Is your blood sugar controlled?	36	36	64	64	1.36	NS
4	Do you smoke?	56	56.0	44	44	1.56	S*
5	Do you have kidney problems?	46	46	54	54	1.46	NS
6	Do you have previous problems with the foot?	36	36	64	64	1.36	NS
7	Have you been beaten or injured in your foot?	58	58	42	42	1.58	S*
8	Do you wear dark shoes?	36	36	64	64	1.36	NS
9	Do you take care of your feet?	66	66	34	34	1.66	S*
10	Do you take the medicine regularly?	50	50	50	50	1.50	S*
11	Do you have a family history of diabetic foot?	42	42	58	58	1.4	NS
12	Have you had diabetes before?	32	32	68	68	1.32	NS
13	Do you wear medical shoes?	42	42	58	58	1.42	NS
14	Do you eat healthy foods for diabetes?	46	46	54	54	1.46	NS
15	Does your work require a long sitting period?	36	36	64	64	1.36	NS
16	Do you exercise regularly?	26	26	74	74	1.26	NS

MOS: Mean of Score, NS: Not Significant (1-1.49), S*: Significant (1.5-2)

Table 3: One-way analysis of variance for the difference risk factors of diabetic foot and age

Age Distribution	SOV	SS	MS	F. Observation
	Between Groups	6.782	16.696	4.407
	Within Groups	187.638	4.170	
	Total	194.420		

F critical: 2.99, Df: 49, MS: Mean square, SOV: Source of variance, SS: Sum of square

Table 4: T-test for comparison for the difference risk factors of diabetic foot and gender

Sex	No.	Mean	SD	T. Observation	p-value
Male	54	23.1852	1.92228	0.153	0.697
Female	46	23.9565	2.03332		

Df: 48, SD: Standard deviation

Table 5: One-way analysis of variance for the difference risk factors of diabetic foot ulceration and education level

Education Level	SOV	SS	MS	F. Observation
	Between Groups	9.363	16.560	4.363
	Within Groups	185.057	4.304	
	Total	194.420		

F critical: 2.99, Df: 49, MS: Mean square, SOV: Source of variance, SS: Sum of square

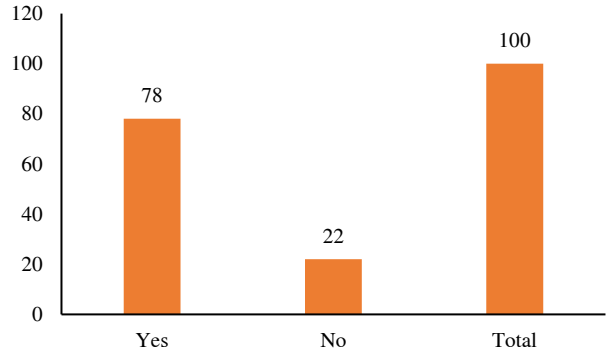

Figure 3: Family history of diabetes among patients

DISCUSSION

DM is a complex and long-lasting disorder that necessities constant medical care with multi-faceted risk-reduction actions to focus on glycemic index control. Iraq has a 21.8 per 1000 people occurrence of DM, with greater rates in urban than rural areas. Also, it was found that DM incidence was more in south and central regions of Iraq compared to the North part [7]. Long-term DM consequences frequently manifest in the feet; thus, foot infection, ulceration or damage of deep foot tissues is related to neuropathy and/or peripheral arterial illness [8]. The main risk factors for DFU among patients are peripheral angiopathy/neuropathy, diminished immunity and poor foot sanitation [9]. Accordingly, we aimed to highlight the risk factors for DFU among patients.

This study showed that most patients were males (54%) and elderly (60-69 years old), which indicated that DM is more common in aged males than females and might result in complications (foot ulceration), most commonly in males due to the type of work [10]. In this regard, Madmoli *et al.* [11] in Iran mentioned that male sex was found to be significantly associated with the development of diabetic foot ulcers more than females, especially among aged patients. Similarly, Ugwu *et al.* [12] in Nigeria stated that DFU and lower limb amputation were more common among aged male patients. However, these results are contrary to that of Ramirez-Perdomo *et al.* [13] reported that females with DFU (68.1%) are more than males, especially those aged 60-69 years old (31.3%).

Little educational levels affect the ability of diabetic patients to understand, process, read and write and consequently impact the quality of their lives. It is also one

of the reasons of social and socioeconomic disparities, which have a more significant effect on the multifaceted situation of patients with DM and increase the risk of DFU development [14]. In this study, most patients were illiterate (24%), while those with Bachelor's and higher education degrees suffered less (4.0%). These results indicated that education level is significant for taking care of metabolic diseases and self-care with health protection. In agreement with this outcome, Ramirez-Perdomo *et al.* [13] in Colombia mentioned that most DM patients had not completed elementary school (34.9%), while those who completed University were 2.0%.

Marriage expressively impacts health outcomes, such as the development and progression of chronic diseases like cancer, hypertension, DM and cardiovascular disease. The correlation between marital status and a specific spotlight on DM has been the chief idea of many studies [15]. Hence, the current study showed that most patients with DFU were married and from urban regions, which might be due to the responsibilities and workload increasing after marriage, such as taking care of babies, stress, more efforts to earn money for life expenses and psychological distress. These outcomes are parallel to another study [12,13,16]; however, Karimi *et al.* [17] in Iran stated that unmarried individuals are more susceptible to DM and consequently, to foot ulcerations. Similarly, Ghassab-Abdollahi *et al.* [18] mentioned that T2DM and DFU were more prevalent among urban female residents.

In the current study, the duration of DM was ≥9 years in most patients (66%), while it was <one year in only 2.0%. These findings do not agree with Alshahrani *et al.* [19] in Saudi Arabia, who stated that most patients (40%) were diagnosed with DM <one year ago, while 9.2% were diagnosed >10 years ago but outcomes are parallel with that of Al Bshabshe *et al.* [20] in Saudi Arabia who mentioned that most patients had diabetes for >10 years (46%), while only 7.3% had it for < a year. This dispersity might be related to the sample size, family history of DM, patient's education level, knowledge about DM and lifestyle.

Furthermore, this study indicated that the most profound chronic diseases among patients were hypertension (24%), heart/joint diseases (16%) and poly nephritis/kidney diseases (12%). In this concern, Negussie *et al.* [21] in Ethiopia reported that diabetic patients had concordant comorbidity, such as hypertension, obesity, dyslipidemia, chronic vascular disease and/or chronic kidney disease. Also, most patients (78%) had a family history of DM, which aligns with that found by Al Bshabshe *et al.* [20] in Saudi Arabia (75.6%). These outcomes collectively agree with what is available in the literature, as the risk of developing T2DM increases ≈ 2-4 times when either or both parents have T2DM. As well as when 60-68.8% of diabetes patients have at least one family member with a history of DM [22].

Moreover, the most significant risk factors for DFU were diseases in the peripheral nerves, smoking, foot injury, not taking care of the foot and not taking medications regularly. These results are explained by the link between DFU and hypertension, nerve problems, uncontrolled hyperglycemia and long-term DM that may affect the amount of blood supply to the feet and sensation that results in foot ulceration and amputation. Other studies mentioned the risk factors for the development of DFU were lack of HbA1c control, foot traumas, mechanical pressures, obesity, smoking, increased diabetes duration, age [23], diabetic peripheral neuropathy, peripheral artery disease, barefoot walking and previous foot ulceration [12].

Moreover, there were significant differences between different risk factors of diabetic foot and each age and gender ($p \leq 0.05$). These outcomes are aligned with the general concept that DM is more common among elderly persons due to increased population life expectancy, sedentary lifestyle and increased obesity. Also, Pscherer *et al.* [24] reported that women and men with DM may differ in the way they face the disease and the way they adhere to the care necessary to keep the disease under control. On the other hand, women have more difficulty maintaining glycemic and lipid control due to lifestyle changes, especially adopting an eating plan and regular physical activity. Finally, significant differences between different risk factors of diabetic foot and education level ($p \leq 0.05$) were observed, which disagrees with that of Chellan *et al.* [25] who mentioned that people with poor knowledge and practice regarding diabetic foot care are known to have a higher incidence of diabetic foot ulcers.

Finally, the limitation of this study included a possible assortment bias in leading a study in a two reference centre and due to the retrospective type of the study, it was not likely to examine the influence of definite sociodemographic and behavioural factors and conduct a detailed investigation of cardiovascular comorbidities.

CONCLUSIONS

The most profound risk factors of patients with DFU were having diseases in the peripheral nerves, smoking, injury in their foot, neglect of care of the foot and not taking medications regularly. Also risk factors of diabetic foot directly correlated to patients' age, gender and education level.

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Conflicts of Interest

The authors declared no competing interests.

Ethical Ethics Approval and Consent to Participate

The Ethical Committee at the College of Nursing, University of Sulaimani, Sulaimaniyah, Iraq, permitted the study procedure (No. 220 on January 2021-UoS). Before starting the study, the researchers explained its aim, nature and expected outcomes to the patients to obtain their acceptance and cooperation. The gathered data were kept confidential and used for study purposes only. Moreover, participation was voluntary and participants had the right to withdraw without obligation.

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